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(12) United States Patent Reed

(54) MONOLITHIC MICROWAVE INTEGRATED CIRCUIT (MMIC) CASCODE CONNECTED TRANSISTOR CIRCUIT

(71) Applicant: Raytheon Company, Waltham, MA

(US)

(72) Inventor: **Thomas B. Reed**, North Reading, MA

(US)

(73) Assignee: **RAYTHEON COMPANY**, Waltham,

MA (US)

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See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

4,315,272 A 2/1982 Vorhaus 5,519,358 A * 5/1996 Tserng H01L 27/0207 257/E27.012

2003/0011008 A1 1/2003 Nelson 2005/0007200 A1 1/2005 Inoue et al. (Continued)

OTHER PUBLICATIONS

Notification of Transmittal of the International Search Report and the Written Opinion of the International Searching Authority, or the Declaration, PCT/US2016/023045, Jun. 27, 2016, 1 page.

(Continued)

Primary Examiner — Phuc Dang (74) Attorney, Agent, or Firm — Daly, Crowley, Mofford & Durkee, LLP

(57) ABSTRACT

A cascode transistor circuit having an active region, the active region having a source, a drain, a floating source/drain, a first gate disposed between the source and the floating source/drain and a second gate disposed between the floating source/drain and the drain. A first gate pad is displaced from the active region and is electrically connected to the first gate and a second gate pad is displaced from the active region and is electrically connected to the second gate. The first and the second gate pads are disposed on opposite sides of the active region.

7 Claims, 9 Drawing Sheets

